

The Adoption of Irrigation By Ohio Farmers

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SUMMARY

Irrigation is the application of water to crop lands that is supplemental or "in addition to" natural rainfall. The adoption of irrigation is increasing in such humid states as Ohio, but the number of farmers using irrigation in Ohio is still less than one percent.

The purpose of the present study was to investigate the adoption of irrigation by Ohio farmers. The major emphasis is upon the sociological aspects in the adoption of this new practice. Most of the data in the present study were secured from 105 responses to a mailed questionnaire which was sent to a random sample of Ohio irrigators in 1958.

The major findings from the present study are summarized as follows:

1. The average Ohio irrigator, when contrasted with the average commercial farmer in Ohio, both operated and owned more land, had a higher level of education, and more frequent contact with agricultural scientists. The irrigators not only tended to adopt new farm practices relatively earlier than their neighbors, but they also recognized this fact about themselves.

2. Personal observation of irrigation on others' farms was the most important single source of information in making farmers aware of irrigation and also in convincing them to adopt the practice. Farm magazines were next in importance at the awareness stage, followed by salespeople from equipment companies. At the conviction stage, personal experience (such as a crop loss due to drought) was second in importance.

3. More than half of the irrigators reported trying out irrigation on a small scale the first year they used it. Farmers who adopted irrigation before 1930 were much more likely to try out the practice on a small scale than were irrigators adopting after 1950.

4. The most important single motivation for adopting irrigation was yield results (increased yield and improved quality). Other reasons were to decrease the drought or frost risk and because of some crises, such as an exceptionally dry year.

5. The adoption of irrigation took place over a great number of years. About three percent of the farmers had irrigated before 1920. Fifty percent adopted in the seven years preceding the study and the evidence suggests that increasing numbers of farmers are adopting irrigation. Many farmers adopted irrigation in 1954.

6. Farmers were aware of irrigation several years before they adopted the practice. The average adoption period was 4.5 years.

7. Commercial concerns were the most important single source of help in laying out irrigation systems. Of lesser importance were county Extension agents and SCS workers.

8. The irrigators personally knew an average of 11 other farmers who were using irrigation. This finding suggests that even though an irrigator's neighbors may regard him with little respect, he received group support from a friendship clique of other irrigators. The irrigator's friends were located over a wide area; 16 percent lived outside of Ohio. Later adopters of irrigation personally knew fewer farmers who were irrigating.

9. Sixty-nine percent of the irrigators had observed the practice in at least one state other than Ohio. Many farmers observing irrigation in other states said this was not influential in convincing them to try the practice.

10. Most irrigators were quite enthusiastic about the use of irrigation. They felt the two main advantages were better quality crops and higher crop yields. Insurance against both frost damage and droughts was also important. The irrigators estimated that their irrigation systems would pay for themselves in about five years.

THE ADOPTION OF IRRIGATION BY OHIO FARMERS

Everett M. Rogers and Ron L. Pitzer*

INTRODUCTION

One is likely to think of irrigation as a practice that is used only in Western states. In recent years, irrigation has become more widely accepted by farmers in humid areas. In 1957, for example, there was at least one farmer using irrigation in all but 15 of Ohio's 88 counties. There were more than 1,000 irrigators in Ohio in 1957.

There is increasing use of and interest in irrigation in Ohio. The increasing trend in irrigated acreage in Ohio is shown by Figure 1. It is estimated that irrigated acreage in Ohio will triple from 1956 to 1966.

Increasing Importance of Irrigation

The need for improved distribution of water and rainfall in humid areas has been recognized for decades. However, the adoption of irrigation in the humid states did not get underway until after World War II. Since that time, there has been a rapid expansion of irrigation in humid areas. Between 1949 and 1954, farmers in the 28 humid states

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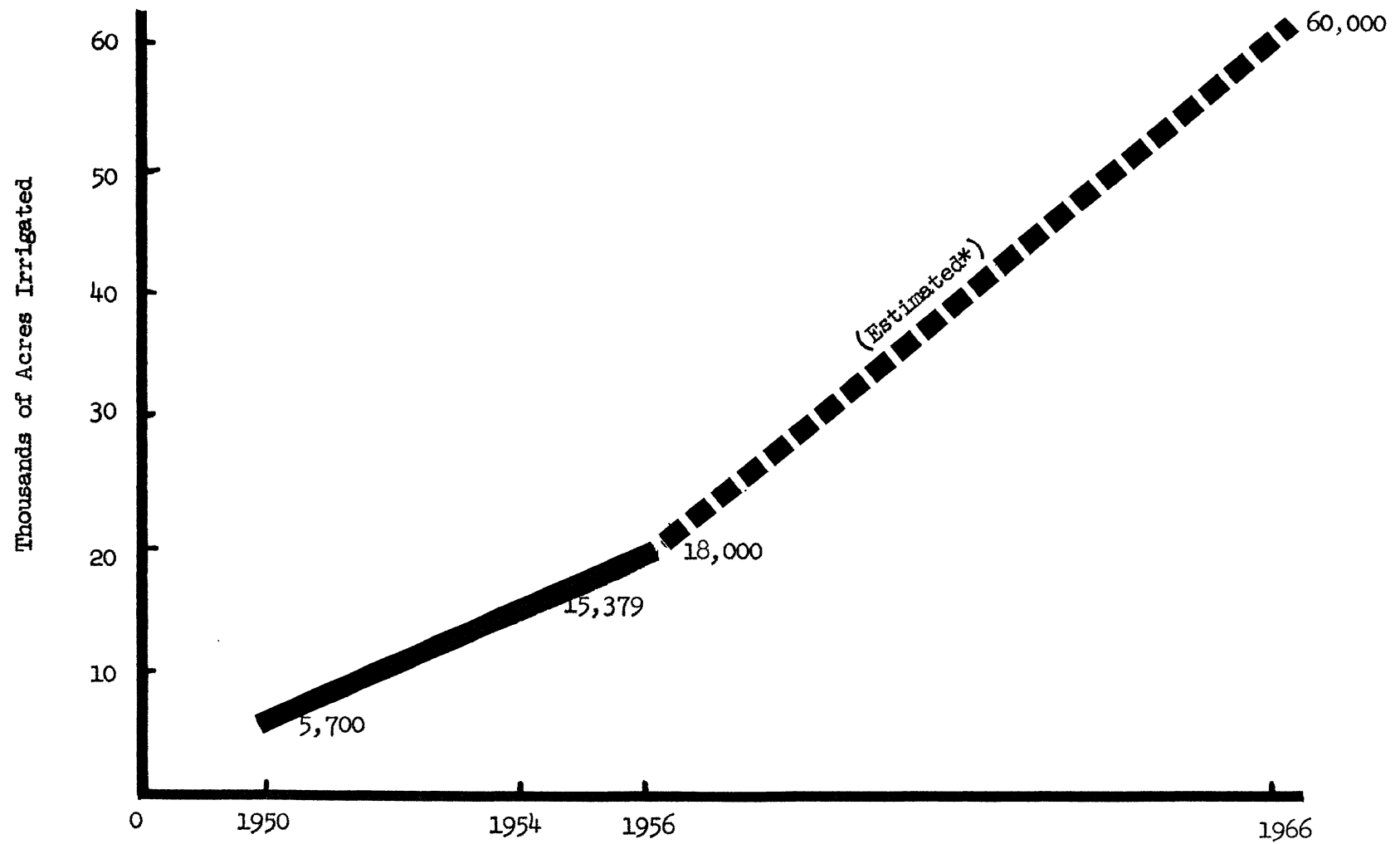


FIGURE 1. THE INCREASING NUMBER OF IRRIGATED ACRES IN OHIO

NOTE: THE ESTIMATED NUMBER OF IRRIGATED ACRES WAS SECURED FROM AGRICULTURAL ENGINEERING 38: 415-421, 1957

(excluding Florida, Louisiana, and Arkansas) east of the Great Plains increased their number of irrigated acres almost four times. In 1949, 153,000 acres were irrigated in the 28 humid states, and by 1954, this figure was 589,000 acres. In Ohio, irrigated acreage almost tripled in this same period.

Intrinsic Nature of the Practice

There are certain characteristics of irrigation which influence its rate of adoption. For one thing, sprinkler irrigation is a high-cost farm practice. A 1954 study of 14,000 irrigators in humid areas disclosed that the average cost of irrigation was around \$5,500 per farm. This figure ranged by states from about \$2,800 to \$10,000 per farm and was about \$4,100 in Ohio.¹ Past research studies have emphasized the importance of adequate credit in the adoption of irrigation. A Kansas study of 61 irrigators in 1955 showed that two-thirds of the farmers borrowed money to establish their irrigation systems.²

Another characteristic of sprinkler irrigation which affects its adoption is that it is highly visible. A farmer's neighbors can see that he is irrigating. Even persons driving by on an adjoining road may often stop and inspect an irrigation system and talk with its owner. As one Ohio irrigator remarked, "Irrigation is pretty in operation,

¹1954 Census of Agriculture, "Irrigation in Humid Areas," Washington, D.C., U.S.D.A., Agricultural Research Service, 1956, pp. 12-19.

²Merton L. Otto and Wilfred H. Pine, "Sprinkler Irrigation Costs and Returns," Manhattan, Kansas, Agricultural Experiment Station Bulletin 381, 1956.

what with the sun shining on the water and all. I have many folks stop by here each year to look at my irrigation layout."

The results from irrigation are also fairly easy to observe. The size and vigor of the irrigated crop and the resulting yields are often spectacular. The respondents in a 1957 irrigation study in Ohio estimated that their yields were doubled by irrigation.³

The availability of irrigation equipment is also a factor affecting rate of adoption. Many of the Ohio farmers who began irrigating before 1930 fabricated their own irrigation equipment. Since 1930, however, equipment has become widely available from commercial concerns. There are several companies in Ohio specializing in irrigation equipment. The use of aluminum in the manufacture of lightweight pipe was an important step in the improvement of equipment.

Sources of information about irrigation have also acted to increase its adoption in recent years. The very early adopters in Ohio (before 1930) relied mainly on their own ingenuity and visits to Western states for information. Since 1930, however, information about irrigation has become more widely available. This occurs as increasing numbers of farmers adopt irrigation and because of the highly visible nature of the practice. Extension Service workers and Soil Conservation Service employees are also becoming better sources of information for potential irrigators.

³Ohio Division of Water, unpublished data.

Factors Affecting Adoption

The detrimental effect of short drought periods during the growing season is one reason for the increasing interest in irrigation in humid areas. This drought hazard is uncertain as to frequency and time of occurrence. The comments of many Ohio irrigators in the present study may be paraphrased as follows: "Irrigation is the best crop insurance I could have--even though I may not need it every season." Severe dry periods may act as a crisis to speed up the adoption of irrigation in humid areas. For example, one Ohio irrigator remarked, "I'd been thinking about using irrigation until 1954 when a dryspell burned up 30 acres of my potatoes. That convinced me." Thus, a drought period may create a crisis situation which motivates farmers to adopt the practice.

Weather data at Columbus, Ohio, were analyzed for the 20-year period from 1936 to 1955 for the growing season (from May 3 to September 27). During this 21-week period each year, there was an average of 7.5 weeks in which the weekly rainfall was less than one-fourth inch. During the 20-year period, there was an average of more than one two week-long dry period per year (with less than one-fourth inch rainfall). About every other year there was a three-week dry spell.

Irrigation is also used in Ohio by strawberry and fruit farmers as protection against frost damage. There may also be an increase in crop quality from the use of irrigation, which is an especially important consideration to truck and vegetable farmers. The desire of farmers to reduce the weather risks in producing high-income farm products is a moti-

vation to adopt irrigation.

The availability and practicality of improved portable equipment is another major reason for the increasing interest in irrigation. More efficient pumps have made it possible to lift more water at less cost. The spread of rural electrification and the development of small tractors and stationary engines provide improved sources of pumping power. Many electric motors and pumps are now built as a unit. The development of light-weight pipe and improved quick-coupling devices were important "break-throughs" in the advance of sprinkler irrigation.

Another important reason for increased interest in irrigation is the economic and social changes taking place in agriculture. For example, the high cost of crop production may motivate the adoption of irrigation. Increasing crop production costs mean that a crop failure is more serious.

Government farm programs may also be one kind of change affecting the adoption of irrigation. Acreage controls on corn, cotton, and tobacco encourage most farmers to produce a higher yield per acre.

The mechanization of modern agriculture has enabled the farmer to enlarge the size of his farming operations without increasing his acreage. Due to the high price per acre of suitable land and the difficulty in obtaining it, many farmers turn to intensification as a means of increasing farming operations. Irrigation provides one means of greater intensification.

Other changes in agriculture affect the adoption of irrigation. Fertilizers and higher-yielding crop varieties have been utilized in humid areas so that now water is often the "limiting factor" preventing further increases in production. Increased planting rates per acre often accompany fertilization and irrigation.

In summary, three of the major factors affecting the adoption of irrigation are the detrimental effect of short drought periods, the availability of improved irrigation equipment and the economic and social changes in agriculture.

Past Adoption Research

The favorite research topic for rural sociologists in recent years has been the diffusion and adoption of new farm technology. Few of these studies, however, have concentrated upon the investigation of one new farm practice. An exception is the pioneering study by Ryan and Gross⁴ of the diffusion of hybrid seed corn in Iowa. The present study is an analysis of the adoption of a single new farm practice, irrigation.

This study is novel in yet another respect. Past research has been concerned with practices that are nearing 100 percent or complete adoption. The practice under analysis in the present study, irrigation, had been adopted by less than one percent of the Ohio farmers in 1958. Thus, these irrigators are all "innovators", or farmers who are the earliest to adopt a new practice. Irrigation may definitely be classified as an "innovation" at the present time.

⁴Bryce Ryan and Neal C. Gross, "The Diffusion of Hybrid Seed Corn in Two Iowa Communities," Rural Sociology 8: 15-24, 1943.

Purpose

The purpose of this study is to investigate the adoption of irrigation by Ohio farmers. Because this is sociological research, the emphasis is placed upon the human relationships and personal influence involved in the adoption of this new practice. In order to fully understand the sociological findings, however, some treatment must also be given to the agronomic, economic, and agricultural engineering aspects of irrigation.

METHODOLOGY

Most of the data presented here comes from 105 responses to a mailed questionnaire which was sent to a random sample of Ohio irrigators in 1958. The sampling frame from which the sample of irrigators were selected was obtained from the Ohio Department of Natural Resources, Division of Water. This agency had personally interviewed 1,035 Ohio irrigators in 1957. The names of these irrigators were provided by county Extension agents, Soil Conservation Service employees, irrigation equipment dealers, VoAg teachers, and other irrigators. Because of the highly visible nature of the practice and because of the thoroughness of the study, it is believed that almost a complete enumeration of Ohio irrigators was obtained by the Ohio Division of Water.

Every fifth name (after a random start) on the list of 1,035 irrigators were mailed a questionnaire in May, 1958. A follow-up reminder was mailed to the non-respondents in June, 1958. Sixteen of the 207 irrigators could not be contacted due to incorrect addresses. Completed questionnaires were received from 117 irrigators which is a 61 percent response from the 191 correct addresses. However, 12 of the 117 completed questionnaires were not usable due to lack of certain information.

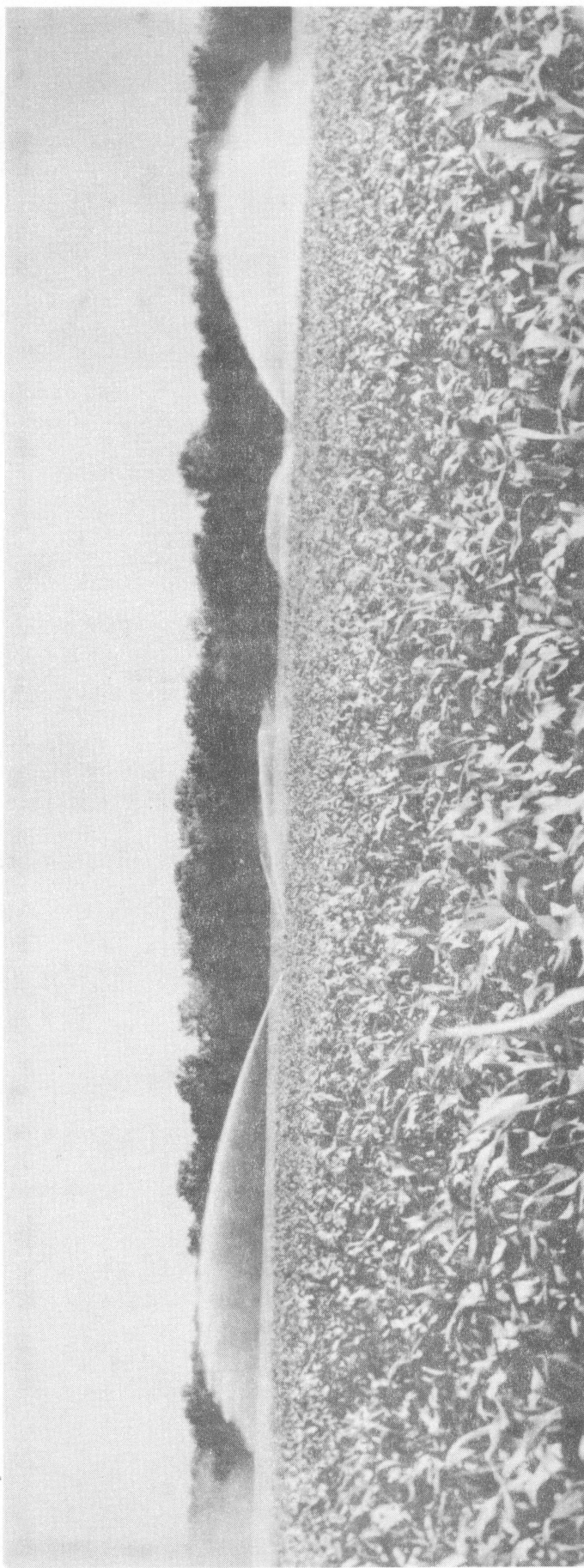


FIGURE 2. CORN AND SWEET CORN ARE IMPORTANT IRRIGATED CROPS IN OHIO

One of the weaknesses in many mailed questionnaire studies is that the non-respondents may differ from the respondents. Thus, the respondents do not represent the total population being studied. It was possible to assess the seriousness of the non-respondent bias in the present study.

Both respondents and non-respondents had been contacted by the Ohio Division of Water in their 1957 study of irrigation. This data enabled comparisons of respondents and non-respondents as to: (1) the year irrigation was adopted, (2) the number of acres irrigated; (3) the crops irrigated, and (4) opinions as to the effect of irrigation on crop yields.

An analysis of these data indicated that non-respondents in the present study had adopted irrigation (on the average) about three years earlier than had the respondents. The average respondent adopted irrigation in 1945 and the average non-respondent in 1942.

Respondents irrigated larger acreages than did the non-respondents. The average for respondents was 34.4 acres and for non-respondents was 20.7 acres. Vegetables were the most important (in acreage) irrigated crop for both the respondents and non-respondents. Greenhouse crops were the second most important crop for non-respondents and the seventh most important for respondents. Field crops such as pasture, fruits, and melons were more important for the respondents.

The tendency for non-respondents to be greenhouse operators suggests that the respondents in the study may be more typical of farmers using irrigation than of all irrigators (which would also include greenhouse operators).

There was no significant difference between the respondents and non-respondents in response to the question, "What effect has irrigation had on your crop yields?"

The location of the 105 respondents was distributed in the same general geographical pattern as the total number of irrigators in Ohio in 1957.

The data from the mailed questionnaires were supplemented by personal interviews with ten irrigators in Central Ohio in 1958.

CHARACTERISTICS OF IRRIGATION INNOVATORS

Personal characteristics and traits of the irrigation innovators involved in this study were determined by questioning these respondents as to their major enterprise, the number of acres farmed and owned, their educational achievement, their adoption of new farm practices and their personal contact with agricultural scientists. These irrigators could then be compared to other farmers in the state on these characteristics. In general, the irrigators were found to both operate and own more land, have a higher level of education, adopt new farm practices earlier, and have more frequent personal contact with agricultural scientists.

Farm Enterprise

Irrigation is used most widely on high value crops such as **truck** crops. Fifty-one percent of the respondents considered themselves fruit or truck farmers; 31 percent, general farmers; and 18 percent nurserymen or greenhouse operators. Fifteen percent of the respondents who considered themselves general farmers also raised some truck crops or fruit, but did not specialize in these enterprises. The major enterprises of the irrigators in the present study were: truck crops, 56 percent; nursery and greenhouse stock, 18 percent; beef cattle, 18 percent; fruit, 15 percent; dairy, 10 percent; and potatoes, 9 percent.⁵

⁵Many farmers mentioned more than one enterprise.

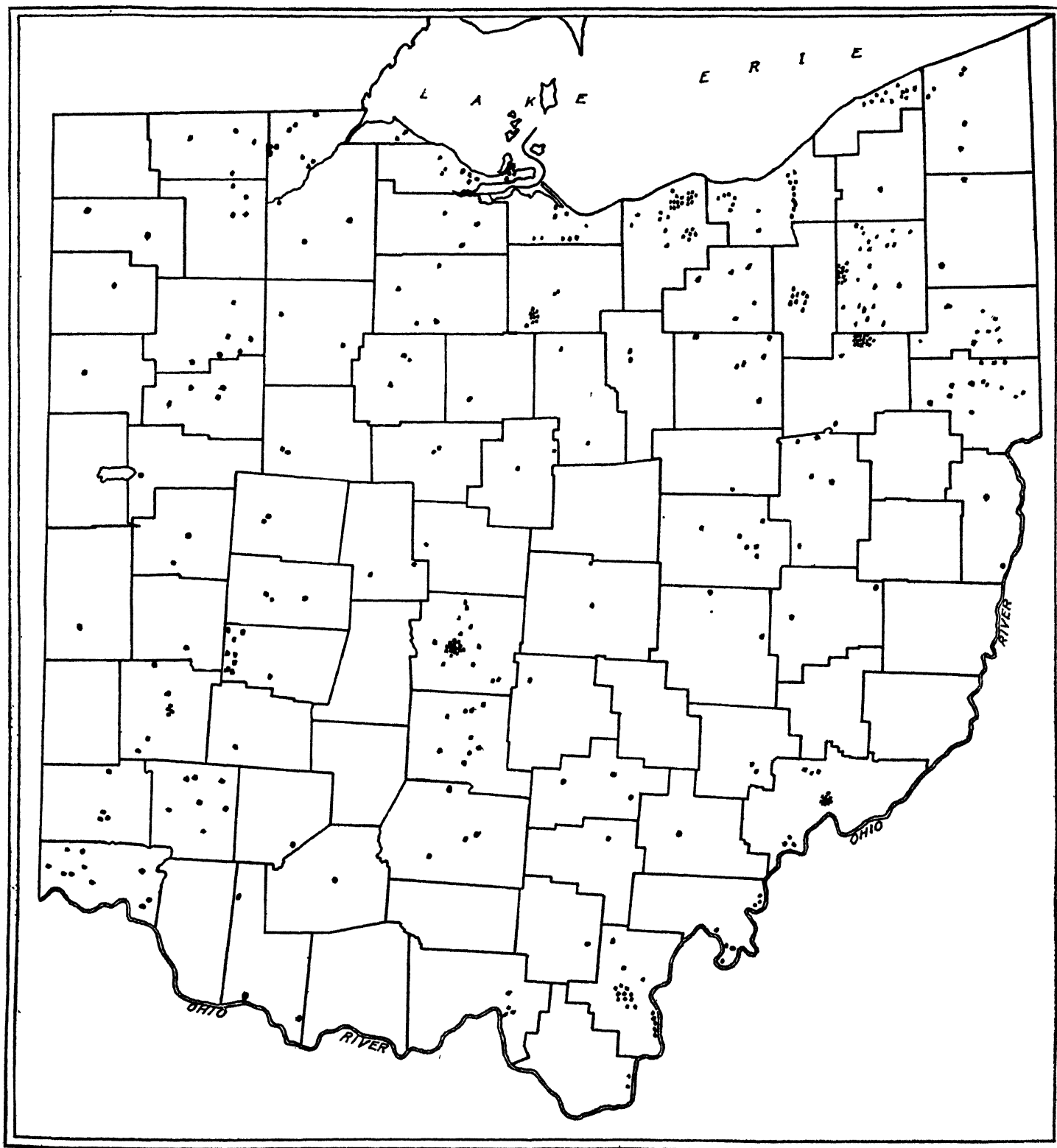


FIGURE 3. OHIO FARMERS USING IRRIGATION IN 1957 *

NOTE; EACH DOT INDICATES ONE IRRIGATOR

Acres Farmed

The acres farmed by the irrigators ranged from a low of 1 acre to a high of 10,000 acres. The percent of farmers in the "under 100 acres" and "over 500 acres" categories is much higher for the irrigators than for the state average of commercial farmers.⁶ There was a tendency for irrigators to operate extremely large or small farms in comparison to the average commercial farmer. The average amount of land farmed by the irrigators was 232 acres, as compared to 182 acres by commercial farmers in Ohio.⁷ This difference would be even greater were it not for the large number of nurserymen (with small acreages) among the irrigators. Figure 6 gives a comparison of the irrigators and the average commercial farmer in Ohio as to total acres farmed.

The amount of farm land owned by Ohio irrigators ranged from none to 3,800 acres. Irrigators are less likely to rent their farm land and are more often owners.

⁶Figures throughout this bulletin for the average commercial farmer in Ohio were obtained in a 1957 study which included a state-wide random sample of Ohio farmers operating more than 20 acres and working off the farm less than 100 days a year.

⁷The irrigators farmed only an average of 138 acres; however, if the one 10,000 acre farm were excluded.

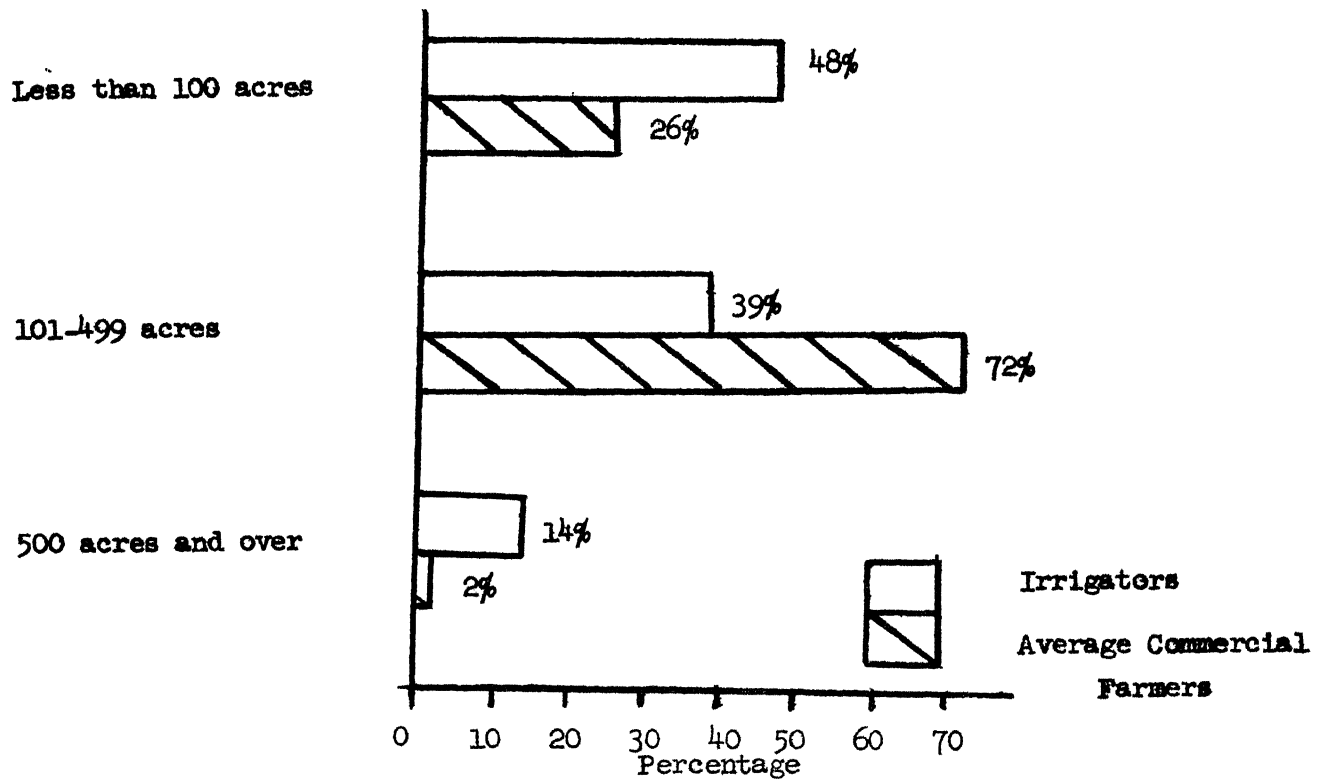


FIGURE 4. NUMBER OF ACRES FARMED FOR IRRIGATORS AND AVERAGE COMMERCIAL FARMERS

Education

The educational level of the Ohio irrigators was considerably higher than that of the average commercial farmer. Seventy percent of the irrigators interviewed had graduated from high school and over 21 percent were college graduates. The irrigators had an average of 12.2 years of schooling while the average Ohio commercial farmer has had an average of 10.1 years of schooling.

Adoption of Farm Practices

A general finding from past research studies is that all persons do not adopt a new technological practice at the same point in time. The adoption of new farm practices is not entirely "consistent" behavior; that is, a farmer who is the first to adopt one new practice will not necessarily be the first to adopt some other new practices. Nevertheless, there is a general tendency for those farmers who are relatively early or late in adopting one practice to be the same way in their adoption of other new practices.

The 105 respondents in the present study were administered an adoption-of-farm-practices scale consisting of six items. These six practices were: 2,4-D weed spray, spittlebug spray, amino triazole for Canadian thistles, Ranger or Buffalo alfalfa varieties, and warfarin rat poison. This adoption-of-farm-practices scale was also administered to a state-wide random sample of commercial farmers. Evidence is presented elsewhere⁷ that this adoption scale measures

⁷Everett M. Rogers, "Categorizing the Adopters of Agricultural Practices," Rural Sociology 23: 345-354; 1958.

the tendency to adopt new practices relatively earlier (or later) than the average farmer. Thus, a high score on the adoption scale would indicate a farmer was more of an innovator than a laggard.

There is tentative evidence that the innovators generally are earlier adopters of new farm practices than is the average commercial farmer in Ohio. The irrigators had higher than average adoption-of-farm-practices scores. There were, however, many irrigators who had below-average adoption scores. Some of these individuals indicated that they adopted irrigation because of a crisis situation (such as a severe drought) or due to special soil factors (such as an especially sandy soil).

Direct Contact With Agricultural Scientists

About 35 percent of the respondents indicated that they had made at least one visit to the Ohio Agricultural Experiment Station or the Ohio State University within the last year.

Sixty-five percent had visited neither the University nor the Experiment Station at Wooster. However, about four percent of the respondents who replied negatively stated that they had visited the Vegetable Crops Substation at Marietta, Ohio. Several who had not made a visit indicated that they would have liked to, but had not found sufficient time.

Figure 5 compares the irrigators to the average commercial farmer as to amount of direct contact with agricultural scientists.

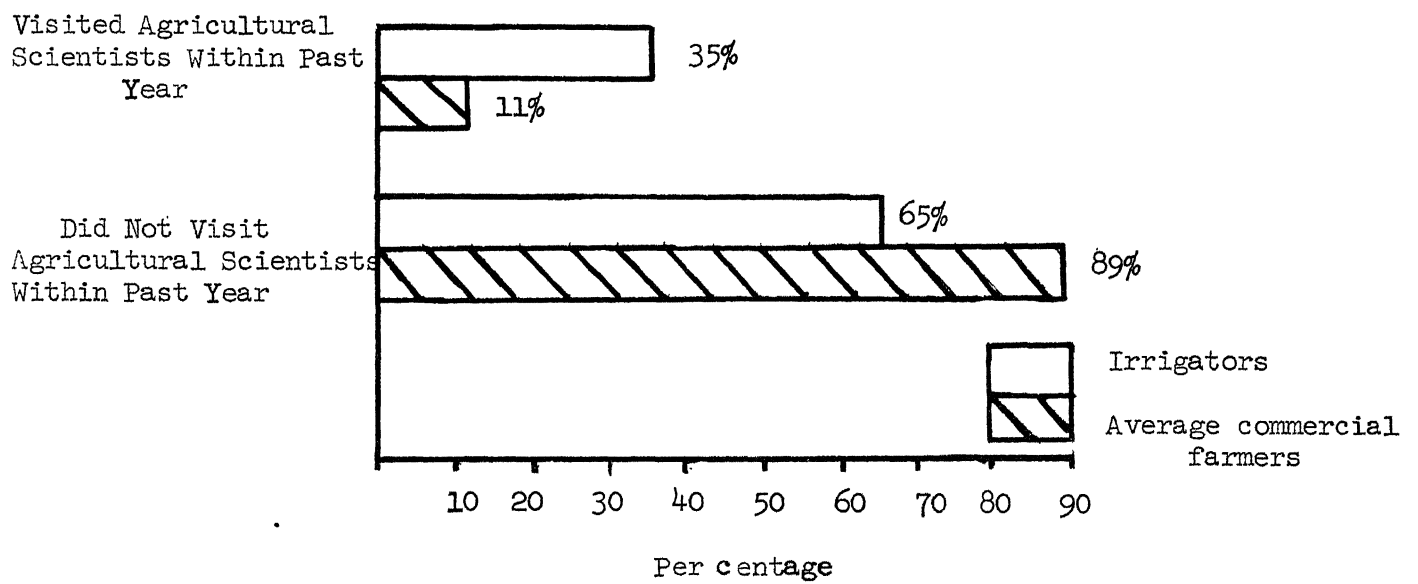


FIGURE 5 DIRECT CONTACT WITH AGRICULTURAL SCIENTISTS FOR IRRIGATORS AND AVERAGE COMMERCIAL FARMERS

THE ADOPTION PROCESS FOR IRRIGATION

The development of new technological practices in agriculture has greatly affected our farm economy. New seed varieties, fertilizers, chemicals, tillage methods, feeds, machines, and many other new practices are constantly being developed and recommended to farmers. Such "change agencies" as the Agricultural Extension Service, the Soil Conservation Service, high school departments of vocational agriculture, and commercial concerns have been vitally interested in the process by which farmers learn about and accept new practices. In recent years, rural sociologists and others have completed considerable research on this adoption process.

A general finding of past research studies is that individuals pass through a series of "stages" in the adoption process.⁸ These adoption stages have been labeled as: awareness, information, application, trial, and adoption. At the awareness stage, the individual is initially exposed to the new idea or practice but lacks details about it. In the information stage, the individual is motivated to seek such additional information about the new practice as its availability and relative advantages. At the application stage, or "mental trial," the relative advantages of the new practice over other alternatives are considered and the decision may be made to actually try out the new practice. In

⁸George M. Beal, Everett M. Rogers, and Joe M. Bohlen, "Validity of the Concept of Stages in the Adoption Process," Rural Sociology 22: 166-168, 1957.

the trial stage, the new practice is given a practical test on a small scale. At the adoption stage, the decision is made either to continue or discontinue use of the practices.

The questionnaire completed by the irrigators provided information as to where and how they first learned of irrigation, what convinced them to try irrigation, and what motivated them to adopt the practice.

Awareness Information

There are many sources from which a farmer can first learn of a new farm practice. Farmers in the sample learned of irrigation by observing irrigation in actual operation. Some irrigators first saw the practice in use in other states; many of them observed it on nurseries or truck farms. Another important way in which farmers became aware of irrigation was by reading farm magazines. Commercial concerns (dealers, salesmen, and manufacturers) were also important. Table 1 shows the percent of farmers receiving their first information from each source.

Table 1 - Most Frequent Sources of Information About Irrigation at the Awareness and Conviction Stages

Source of Information	Awareness Stage Percent of Irrigators	Conviction Stage Percent of Irrigators
Personal Observation on Others' Crops	41	41
Farm Magazines	21	10
Commercial Dealers, Salesmen and Manufacturers	13	12
Own Experience (Droughts and Crop Losses)	7	22
University and Extension Service	6	10
Relatives	6	2
Friends	2	0
Other	4	3
Total	<u>100</u>	<u>100</u>

Personal observation on others' crops included seeing the practice in actual use both in and outside of Ohio. Local (inside Ohio) observation included seeing irrigation in operation on neighbors' farms and on the farms of truck gardeners and nurserymen.

At the awareness stage, local observation comprised 29 percent of the total sources of information on irrigation, and out-of-state observation included 12 percent. At the conviction stage, local observation comprised 34 percent and out-of-state observation, 7 percent of the total.

Past findings have generally shown that farm magazines are the most important source of information about new farm practices at the awareness stage. One reason for the importance of personal observation as a source of information for irrigation may be the fact that irrigation is such a highly "visual" practice. It is a practice that can be seen and is one that attracts attention.

Conviction Information

The most important factor convincing farmers to try irrigation was the results and effect of irrigation on the crops of other irrigators--especially nurserymen. Personal experiences of the irrigators (e.g., high crop losses due to lack of moisture) were also important.

Next most important factor contributing to conviction was information received from commercial concerns. Farm magazines were the fourth most important conviction source followed by the Ohio State University and the Agricultural Extension Service. (Table 1).

Other factors contributing to conviction were observation and advice of neighbors, observation of irrigation both in and out of the state and the advice and encouragement of relatives. Compared to sources of awareness information, farm magazines were less important and "own experience" was more important at the conviction stage. Personal observation of others' irrigated crops was the most important single source of information at both the awareness and conviction stages. There was a tendency for this personal observation to be more local rather than out-of-state at the conviction stage.

Trial on a Small Scale

The irrigators were asked if they had first tried irrigation on a small scale. Past research findings have indicated that most farmers try out a new practice on a small scale before adoption as a means of finding out more information about the practice. Fifty-eight percent of the irrigators replied that they had tried irrigation on a small scale the first year they used it, while 42 percent indicated that they had gone immediately into a full-scale operation.

A higher percentage of the irrigators who adopted before 1930 tried irrigation on a small scale than those who adopted irrigation after 1950. This is probably because the early users of irrigation had no other reliable means of evaluating the practice, whereas the later adopters could rely on the results and experience of the early users. Table 2 shows the percent of farmers using irrigation on a small scale the first year by their time of adoption. Not all irrigators reported that they tried out the practice on a small scale, but the percentage of those who did decreased rather consistently from the early users to the late users.

Table 2 - Farmers Using Irrigation on a Small Scale the First Year by Time of Adoption

Time of Adoption	Percent of Farmers Trying Irrigation
Before 1930	86
1930-1939	85
1940-1949	67
1950-1957	41

Adoption Motivations

The irrigators were asked why they had decided to continue using irrigation. There seemed to be three general reasons for the adoption of this practice. One of these was because of some crisis which they had experienced, such as an exceptionally dry year. Another reason mentioned frequently was to decrease the risk of future drought or frost damage. A third reason, which was the most frequently mentioned of all, was the good results (increased yield and improved quality) experienced during the trial period. Table 3 summarizes the respondents' expressed motivations to adopt irrigation. There is obviously a great deal of overlap among some of these reasons.

Table 3 - Motivations for Adopting Irrigation

Reason for Adopting Irrigation	Percent of Irrigators
Increased Crop Yields	34
Assured Prevention of Drought or Frost Damage	33
Improved Quality of Crops	21
Good Results During First Year	19
Experience During a Very Dry Year	6
Necessary Because of Soil Type	3
Others	9
Multiple Total*	<u>125</u>

*Some of the irrigators gave more than one reason.

Occasional droughts seem to act as proof to irrigators that their investment in irrigation equipment was a wise decision. As one irrigator remarked, "Last year I had full production (yields) on my tomatoes. Without irrigation, it would have been almost a complete loss."

Another irrigator's remarks sum up the main advantages of irrigation as listed by the respondents:

"I think that irrigation is the best investment any farmer can make today. Main reasons are quality and yield of produce, frost protection and insurance against drought. I think that I can convince anyone that irrigation is a must."

TIME OF ADOPTING IRRIGATION

Past research findings have indicated that a number of years usually elapse between the time a new practice is developed or discovered and the time when it is widely adopted by farmers. This is partly because it takes several years for the practice to be diffused to farmers and because many farmers are reluctant to adopt a practice until its value has been satisfactorily demonstrated on a neighbor's farm.

Time of Adoption

Figure 6 shows the distribution of adoption dates for irrigation. Less than 3 percent of the farmers had adopted irrigation before 1920; 8 percent had adopted it before 1930; 27 percent before 1940; and only 50 percent before 1950. Fifty percent adopted the practice

during the period 1950-57.⁹ There were many adopters in 1954, which many farmers regarded as a "dry year." The annual rainfall that year was 34.3 inches which is near the long-time average of 35.8 inches per year. However, 1954 was preceded by a rather dry year (27.8 inches of rainfall in 1953).¹⁰ The growing season during 1954 was especially dry. There was one four-week period with less than one-fourth inch of rain per week. This lengthy drought speeded the adoption of irrigation in 1954.

Time of Awareness

Figure 6 also shows the distribution of awareness dates for irrigation. Five percent of the irrigators were aware of irrigation before 1920; 21 percent were aware of the practice before 1930; 39 percent before 1940; and 64 percent were aware of irrigation before 1950. This means that 36 percent were not aware of the use of irrigation until the period 1950-57.

⁹There was general agreement between the present data as to time of adoption of irrigation and the data from the U.S.D.A. 1954 study of irrigation, op. cit., p. 88.

¹⁰Rainfall data were obtained from the Columbus Airport Weather Station.

Per Cent of
Irrigators

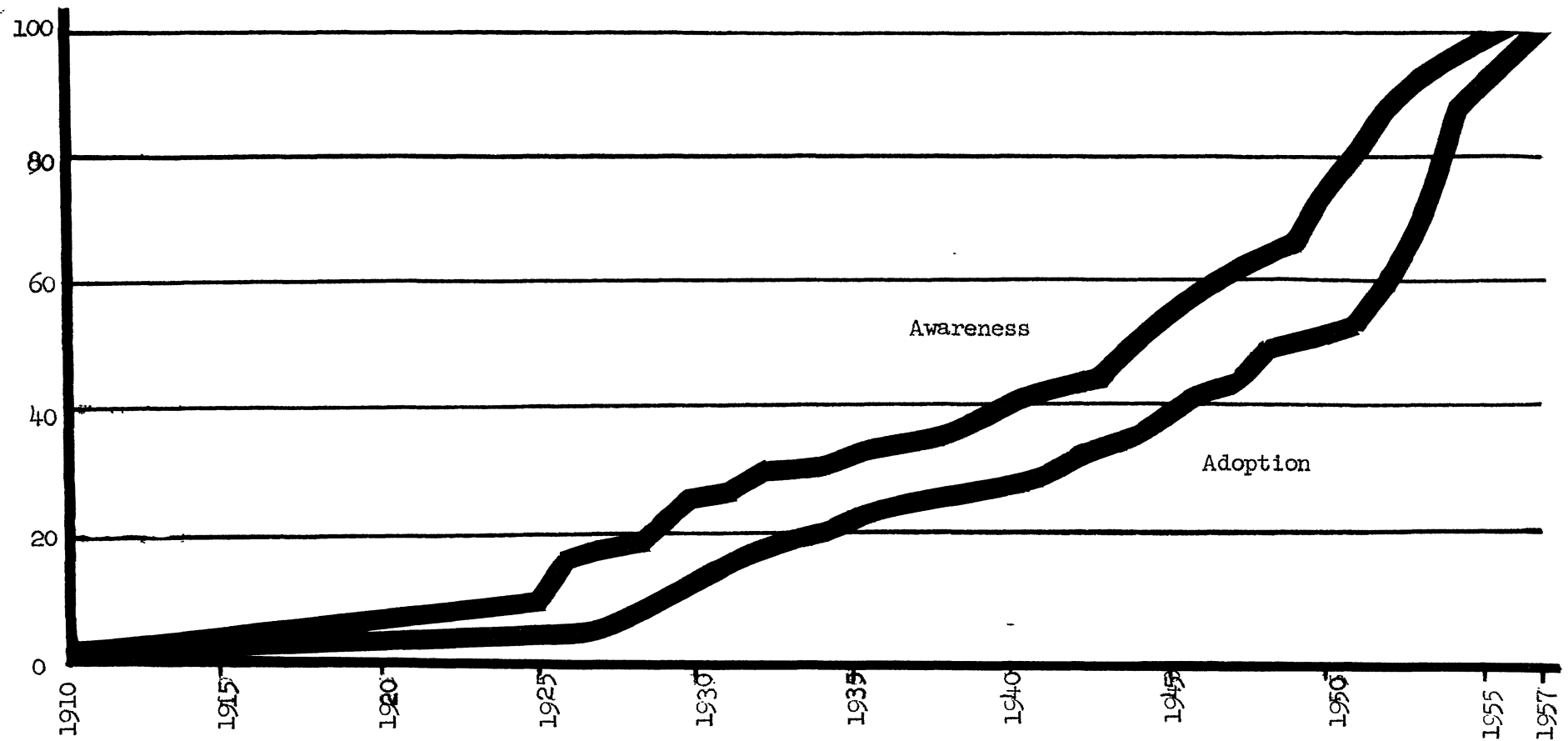


Figure 6. Comparison of Awareness and Adoption Dates for Irrigation

Length of the Adoption Period

The length of the adoption period is shown as the difference between the awareness and the adoption curves in Figure 6. The adoption period is the time between awareness (first information) and adoption. The average length of the adoption period for the farmers in this study was 4.5 years. In other words, the average farmer waited about 4.5 years after first hearing about irrigation before he adopted it. The average adoption period for hybrid corn, in comparison, was found to be five years.¹¹

The adoption periods for such practices as 2,4-D weed spray, Warfarin rat poison, antibiotic feed supplements, and commercial fertilizers have been found to be less than two years. One reason that a relatively longer adoption period is required for irrigation may be its complexity, high cost, and the relatively small percentage of farmers who have adopted.

SOURCES OF INFORMATION SOUGHT BY IRRIGATORS

Past writings about innovators have suggested that due to the very newness of the practices at the time they adopt, innovators are forced to rely mainly on their own observation or ingenuity in learning about and adopting a new practice. In order to test this hypothesis, the irrigation innovators were asked for such information as: the help they received in laying out their irrigation

¹¹Ryan and Gross, op. cit.

system; the help they received from the county Extension agent, SCS workers, dealers and salesmen, and other farmers; the information they received from outside the state; and what further information they felt they needed.

Help in Laying Out Irrigation System

Twenty-six percent of the irrigators said they received no help in laying out their irrigation system. The most important single source of help was from commercial concerns (salesmen, dealers, or engineers from the equipment companies). Fifty-nine percent of the irrigators mentioned help from this source. This finding might be expected for two main reasons: (1) at the time many irrigators adopted, commercial concerns were the best and possibly the only source of information available to them; and (2) the practice required the purchase of irrigation equipment in order to adopt its use.

Other sources of help mentioned were friends, relatives, neighbors, The Ohio State University, the county Extension Agents, and the Soil Conservation Service.

County Extension Agent

About 17 percent of the irrigators had asked their county agent for information about irrigation. Of those who did ask for information, 12 percent said the reason that they did not receive help was because the agent knew little about the practice. Twenty-four percent of those who asked for information were referred to an

Extension specialist or to bulletins. Others received information as to size of layout required for proper coverage, amount and rate of application, type of sprinkler best adapted to their situation and sources of water.

Soil Conservation Service

About 14 percent of the irrigators had asked SCS workers for information about irrigation. Of those who did ask SCS workers for information, 14 percent were advised not to adopt irrigation, and another 21 percent reported that they received no help. The help received was mostly in regard to the effect of soil type on irrigation, construction of farm ponds, available water supply, and drainage.

Dealers and Salesmen

Fifty-nine percent of the farmers in this study indicated that they were urged by equipment dealers or salesmen to adopt irrigation. Seventy-three percent of these farmers said they received the information they sought from salesmen or dealers. Six percent of those receiving information stated that the information was biased or false and was given by salesmen or dealers interested only in selling their equipment.

Most of the information received from salespeople was considered helpful by the irrigators. Twenty-six percent received information on the type of equipment most suitable; 23 percent on the size required; 14 percent on the costs and price of irrigation equipment; 14 percent on the results, value, and effects of irrigation; and 12 percent on the engineering and operation of the irrigation system.

Other items mentioned were rate of application, time to irrigate, planning and layout of system, sprinkler spacings, and demonstrations and movies of irrigation.

Other Farmers

The irrigators were asked, "How many other farmers do you know personally who are irrigating?"

A few irrigators knew no other farmers personally who were irrigating and a few said they personally knew as many as 100 or more. The irrigators personally knew an average of 11 other farmers who were using irrigation. This indicates that innovators often belong to a "friendship clique" with a favorable norm on irrigation. We do not know, however, whether these men belonged to this clique before they used irrigation and were influenced to use it because of the clique; or whether they were admitted to the clique after they adopted irrigation.

The location of these irrigating friends was obtained by asking the respondents where these friends lived: in the same neighborhood, in the same county or outside of Ohio. The results are summarized in Table 4. Many of the irrigators knew other irrigators in more than one of the suggested areas.

Table 4 - Location of Other Irrigators Personally Known by the Respondents

Location of Friends Who Irrigate	Percent of Irrigators
In the Same Neighborhood	57
In the Same County	62
In Ohio, But Out of the Same County	11*
Outside of Ohio	16

*This response was not suggested, so it is probably highly underestimated.



FIGURE 7. OHIO IRRIGATORS SAID THEY PERSONALLY KNEW AN AVERAGE OF ELEVEN OTHER IRRIGATORS AND OFTEN VISITED WITH THEM

An example of a friendship clique is provided in the account of one county Extension agent:

All the irrigators in this county know each other. They visit back and forth--even if it means driving all the way across the county. They get together and discuss when to irrigate and how much to put on and their irrigation equipment. Some even travel out of the county. John Smith drives up to Columbus every few weeks to chat with a guy up there who also irrigates sweet corn.

Previous research has indicated that innovators are generally regarded by their immediate neighbors with little respect. The findings suggest that irrigators are impervious to this group pressure from their neighbors. But the present study also indicates that innovators do receive group support for their ideas from another source. While their neighbors are relatively unimportant to them as friends, the present findings suggest that innovators do belong to a group of geographically distanced friends who favor the innovation.

Farmers who adopted irrigation earlier generally tended to know more irrigators personally (although the trend is not entirely consistent). The average number of irrigators known personally is shown below on the basis of year of adoption of irrigation.

<u>Year of Adoption of Irrigation</u>	<u>Average Number of Irrigators Known Personally</u>
Before 1930	16.0
1930 to 1939	14.9
1940 to 1949	15.2
1950 to 1957	6.8

This finding suggests that perhaps an irrigator gradually becomes integrated into a friendship clique of other irrigators in succeeding years after he adopts irrigation. On the contrary, this finding might mean that the earlier adopters of irrigation belonged to larger friendship groups with other irrigators.

Sources of Information Outside of the State

Past research findings have indicated that innovators of farm practices travel widely. The results of the present study confirm these past findings. Sixty-nine percent of the irrigators had observed the practice in at least one other state. These farmers, as a whole, had observed irrigation in two-thirds of the states, plus Canada and Cuba. Florida (32 percent), California (26 percent), and Arizona (15 percent) were mentioned most often. Texas, Michigan, New Jersey, and New York were each mentioned by over 10 percent of the irrigators.

The irrigators were then asked, "Was observing the practice in these states influential in your decision to irrigate?" Sixty-two percent of the respondents who had seen the practice in other states said this was not influential in convincing them to try irrigation; 38 percent said it was influential in their decision.

Needed Information

The most needed information about irrigation (as indicated by the respondents) is when and how often to irrigate, the proper amount of water to use, how to determine soil moisture content simply, how to apply fertilizer with the irrigation system, how to move the equipment easily, the effect of irrigation on prevention of frost damage, sources of water, and the legal aspects of water rights.

IRRIGATORS AS SOURCES OF INFORMATION FOR OTHER FARMERS

Research findings have indicated that there is a "two-step flow of communication" between the change agent and the farmer. This means that information concerning new farm practices is diffused from county agents, SCS workers, etc. to the innovators who try out and demonstrate the practice to other farmers. This process (often called the "diffusion" or "trickle-down" process) is generally effective in eventually convincing even the more cautious farmers of the value of new practices.

To determine whether the two-step flow of communication is also applicable in the case of irrigation, the respondents were asked the number and type of people visiting their irrigation systems during the past year and also the attitude of their neighbors toward irrigation.

Persons Visiting Irrigators

Eighty-six percent of the respondents said they had been visited by at least one person interested in their irrigation system within the year preceding the study. The number of people visiting these irrigators ranged from zero to 50 with an average for all respondents of 4.5.

As might be expected, the most frequent visitors were neighbors. Farmers from miles away, and dealers or salesmen were the next most common types of visitors. About one-third of the irrigators received visits from county Extension agents or SCS workers interested in learning about irrigation. Table 5 lists the types of visitors and the percent of irrigators visited by each.

Table 5 - Percent of Irrigators Visited by Various Types of People

Type of Visitor	Percent of Irrigators
Neighbors	89
Farmers from Miles Away	48
Salesmen or Dealers	48
County Extension Agents and SCS Workers	32
Farm Magazine Editors	17
Nurserymen	5
Friends or Visitors from City	5
Others	5

Attitude of Neighbors

A wide range of neighbor attitudes toward irrigation were reported by the respondents. Some neighbors were so convinced of the value of irrigation that "they would not be without it"; other neighbors thought irrigation was "all right if you could afford it"; still others thought that irrigators were "crazy" for using the practice.

In order to get an idea of the general attitude of neighbors from the open-ended question, "What do your neighbors think of irrigation?" a rough measure of favorableness of attitude was developed. The respondents' remarks were rated by three judges using a five-point rating scale from "highly favorable" to "highly unfavorable." Agreement between the three judges was measured by means of the Robinson measure of agreement, "A."¹² Agreement between judges E and R was .97, between judges E and S

¹²W. S. Robinson, "The Statistical Measurement of Agreement," American Sociological Review, 22: 17-25, 1957.

was .90, and between judges R and S was .89. This indicates that the three judges made fairly objective ratings as to the respondents' statements.

In general, the neighbors' attitude toward irrigation was somewhere between favorable and slightly favorable (i.e., they thought it was a "good practice"). However, there seemed to be some undercurrent of feeling by many neighbors that although the practice was obviously advantageous, it was "too expensive" or "not suitable" for their own operation. Some of the comments were "think it is O.K.", "think it is good," "some for, some against," "would like to have it, but fear the cost," "think it is excellent," "fine if you can afford it," and "considering using it." Table 6 summarizes the neighbors' feelings toward irrigation.

Table 6 - Attitudes of Neighbors Toward Irrigation

Attitude of Neighbors	Percent of Irrigators
Highly Favorable	19
Favorable	34
Slightly Favorable	25
Unfavorable	14
Highly Unfavorable	<u>8</u>
Total	100

EVALUATION OF IRRIGATION

Main Advantages of Irrigation

The two advantages of irrigation most often mentioned by irrigators were better quality crops and higher crop yields. About 83 percent of the farmers interviewed mentioned higher crop yields as an important reason for irrigating. Better quality crops were listed by 76 percent of the irrigators.

Insurance against frost damage was mentioned by 42 percent of the farmers, and insurance against dry seasons was an advantage volunteered by about 21 percent of the farmers. This latter reason was not suggested; had it been, many more farmers probably would have mentioned this advantage. Insurance against frost seemed to be especially important with some crops, such as strawberries.

The farmers in the present study generally indicated they were personally "sold" on the use of irrigation. As one respondent remarked, "I wouldn't raise potatoes without irrigation." The attitude of the farmers presently using irrigation is pretty well summed up by the statement of one irrigator, "Throwing a life preserver in the direction of a drowning man keeps him from sinking if he gets it. Irrigation is similar in that the farmer must get water in dry seasons to keep from sinking."

Anticipated Years Required to Pay for Equipment

The question was asked, "How many years did you think would be required to pay for the cost of your irrigation equipment with your irrigat



FIGURE 8. OHIO IRRIGATORS REPORTED THAT KNOWING WHEN TO IRRIGATE AND HOW MUCH WATER TO APPLY WERE IMPORTANT PROBLEMS

profits?" In general, irrigators felt that the practice was a long-term investment which would not pay off immediately, although as one farmer commented, "In a real dry season it could pay for itself the first year."

The anticipated time required for irrigation systems to pay for themselves ranged from 1 to 12 years with an average estimate of just under 5 years. Seventy-one percent of the farmers thought it would require five years or less for the system to pay for itself, while 29 percent thought it would take from 6 to 12 years.

Effect on Yields

The respondents were generally enthusiastic about the effect of irrigation on their crop yields. Many reported that their crop yields were doubled as a result of irrigation; few, however, considered the separate effect of irrigation alone. The respondents' estimates of yield responses from irrigation also included the effects of increased fertilizer application and thicker plant spacing. The application of irrigation water often shifted the "limiting factor" on crop yields from water to some other factor such as fertilizer, plant spacing, or crop variety. Unless these other limiting factors were also changed, the full effect of irrigation was seldom realized.

DISCUSSION

The purpose of this publication was to investigate the sociological aspects of the adoption of irrigation by Ohio farmers. It should be apparent from the findings of this study that group relationships exert an important influence in the adoption of a major new farm practice by innovators. For example, it was found that irrigators were definitely member

of friendship groups with other irrigators, even though these "irrigator cliques" often covered an area of several counties.

Previous hypotheses about the communication behavior of agricultural innovators suggested that mass media sources of information were most important. Thus, it is an especially significant finding in the present study that group relationships and personal influence are important for innovators. Innovators play a crucial role in the diffusion of new practices; future research efforts could well be concentrated upon the further study of innovator behavior.

Most past research by rural sociologists has concentrated upon the study of new practices that are almost completely adopted by farmers. There certainly is a need for further research on new technological practices that are in the early stages of acceptance. Perhaps one goal of this type of research effort might eventually be to predict the rate of adoption of a new practice before it is even released by scientists to the public.

One shortcoming of the present study is that the respondents only included those farmers who had a successful experience with irrigation and continued using it. There undoubtedly are also many farmers (the authors heard of several in the course of the present study) who tried irrigation and found it unsatisfactory for their farming situation. Just as there is a need to study the motivations of those farmers who adopt a new practice, so is there a need to investigate the reasons why some other farmers reject the same practice. This is, to date, a relatively unexplored area of adoption behavior.